[0048] In both the external screen device and visual indicator cell phone of the present invention, a variety of electro-optic media may be used. The electro-optic medium could, for example, be of the rotating bichromal object type as described, for example, in U.S. Pat. Nos. 5,777,782 and 5,760,761. The electro-optic medium could also be an electrochromic medium, a preferred electrochromic medium being a nanochromic film comprising an electrode formed at least in part from a semi-conducting metal oxide and a plurality of dye molecules capable of reversible color change attached to the electrode. Nanochromic films of this type are described, for example, in International Applications Publication Nos. WO 98/35267 and WO 01/27690; the entire contents of these two applications are herein incorporated by reference.

[0049] However, the presently preferred type of electro-optic medium is an electrophoretic medium, preferably an encapsulated electrophoretic medium. Electrophoretic displays have been the subject of intense research and development for a number of years. Such displays can have attributes of good brightness and contrast, wide viewing angles, state bistability, and low power consumption when compared with liquid crystal displays. Numerous patents and applications assigned to or in the names of the Massachusetts Institute of Technology and E Ink Corporation have recently been published describing encapsulated electrophoretic media. Such encapsulated media comprise numerous small capsules, each of which itself comprises an internal phase containing electrophoretically-mobile particles suspended in a liquid suspension medium, and a capsule wall surrounding the internal phase. Typically, the capsules are themselves held within a polymeric binder to form a coherent layer positioned between two electrodes. Encapsulated media of this type are described, for example, in U.S. Pat. Nos. 5,930,026; 5,961,804; 6,017,584; 6,067,185; 6,118,426; 6,120,588; 6,120,839; 6,124,851; 6,130,773; 6,130,774; 6,172,798; 6,177,921; 6,232,950; 6,241,921; 6,249,271; 6,252,564; 6,262,706; 6,262,833; 6,300,932; 6,312,304; and 6,323,989, and in International Applications Publication Nos. WO 97/04398; WO 98/03896; WO 98/19208; WO 98/41898; WO 98/41899; WO 99/10769; WO 99/10768; WO 99/10767; WO 99/53373; WO 99/56171; WO 99/59101; WO 99/47970; WO 00/03349; WO 00/03291; WO 99/67678; WO 00/05704; WO 99/53371; WO 00/20921; WO 00/20922; WO 00/20923; WO 00/26761; WO 00/36465; WO 00/38000; WO 00/38001; WO 00/36560; WO 00/36666; WO 00/59625; WO 00/60410; WO 00/67110; WO 00/67327 WO 01/02899; WO 01/07691; WO 01/08242; WO 01/17029; WO 01/17040; and WO 01/80287. The entire disclosures of all these patents and published applications are herein incorporated by reference.

[0050] An encapsulated, electrophoretic medium typically does not suffer from the clustering and settling failure mode of traditional electrophoretic media and provides further advantages, such as the ability to print or coat the display on a wide variety of flexible and rigid substrates. (Use of the word "printing" is intended to include all forms of printing and coating, including, but without limitation: pre-metered coatings such as patch die coating, slot or extrusion coating, slide or cascade coating, curtain coating; roll coating such as knife over roll coating, forward and reverse roll coating; gravure coating; dip coating; spray coating; meniscus coating; spin coating; brush coating; air knife coating; silk screen printing processes; electrostatic printing processes; thermal printing processes; ink jet printing processes; and other similar techniques.) Thus, the resulting display can be flexible. Further, because the display medium can be printed (using a variety of methods), the display itself can be made inexpensively.

[0051] Since the preferred types of encapsulated electrophoretic media for use in the present invention are identical to those described in the aforementioned patents and applications, they will not be described in detail herein, the reader being referred to these patents and applications for full details.

[0052] Preferred embodiments of the invention will now be described, though by way of illustration only, with reference to the accompanying drawings.

[0053] The external screen device of the present invention shown in **FIG. 1** is a cell phone (generally designated **10**) having a substantially cuboidal housing to one side of which is attached an antenna **12**. The front surface **14** of the housing carries an earpiece **16**, a small internal screen **17** for the display of data, a main key pad **18** comprising ten keys numbered 1-9 and 0 in the conventional key pad layout (the markings on these and other keys described below are omitted from the drawings to avoid unnecessary clutter), and an auxiliary key pad **20**, which contains six keys used for special functions needed in a cell phone, such as "power", "send" etc. Finally, the front surface **14** carries a microphone **22**. All the components of the cell phone **10** so far described are conventional and hence will not be further described herein.

[0054] However, in addition, the cell phone **10** is provided with a flexible external screen **24**, which is movable between an extended position, shown in **FIG. 1**, in which the screen is held substantially flat so that the full display area of the screen is visible to a user, and a retracted position, shown in **FIG. 2**, in which the screen **24** is "folded" in a serpentine configuration against the housing of the cell phone. The screen **24** comprises an encapsulated electrophoretic medium ("an electronic ink") on which data from the cell phone can be displayed.

[0055] The screen **24** is provided, along its edge remote from the housing, with an end member **26**, which is formed of a rigid plastic material and which bears four push buttons **28** and a miniature trackball **30**; when the trackball **30** is in use, the lower two (in **FIG. 1**) of the push buttons **28** are employed as the buttons needed for the trackball **30** to be used in the conventional manner.

[0056] The cell phone **10** further comprises a top support member **32**, a bottom support member **34** and an end support member **36**, which together form a frame surrounding the screen **24** and the end member **26**. (Those skilled in mechanical engineering will appreciate that some interlocking mechanism is needed to enable to support members **32**, **34** and **36** to be stable in the positions shown in **FIG. 1** but still able to move to the positions shown in **FIG. 2**, as described below. However, since such interlocking mechanism can be of any conventional type, it will not be described in detail herein.) The end member **26** extends slightly beyond the side edges (the top and bottom edges as illustrated in **FIG. 1**) of the screen **24** and the projecting end portions of the end member **26** are received into recesses **38**